

HECC Application Performance and Productivity

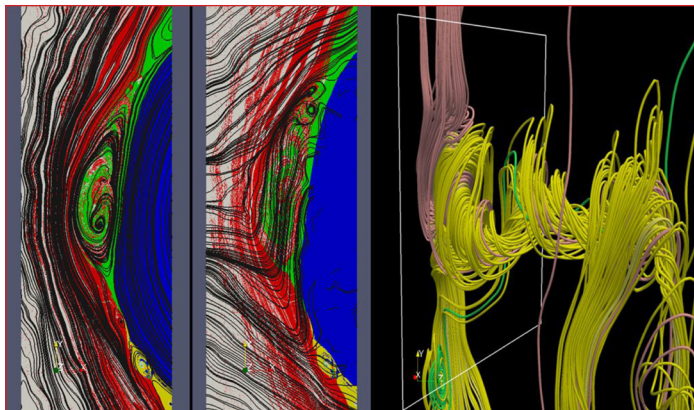
High-End Computing

The Application Performance and Productivity (APP) group of the High-End Computing Capability (HECC) Project at the NASA Advanced Supercomputing facility has three key activities: enhancing performance of high-end computing applications, leveraging software technologies to improve user productivity, and characterizing performance of current and future architectures.

Application optimization efforts this year boosted the performance of several key codes, including: the 3D Hybrid (3DH) Earth magnetosphere simulation code, the Numerical Prediction of Orbital Events (NPOE) code, the AKIE turbomachinery code, and the OVERFLOW computational fluid dynamics code. Extensive code-building and troubleshooting efforts enabled one of the largest 3DH simulations to date, which used 25,000 cores on the Pleiades supercomputer and 40 terabytes of disk space. We also accelerated NPOE simulations by 15 times—enabling generation of critical mission requirements for the Interface Region Imaging Spectrograph (IRIS) spacecraft—and parallelized a version of AKIE using OpenMP, obtaining a nearly 8-fold speed-up. For OVERFLOW, we analyzed and enhanced code performance to scale almost linearly over a large range of cores on all three types of processors on Pleiades.

The APP group regularly characterizes performance of new supercomputing architectures using a suite of NASA-relevant codes, including both benchmarks and full applications. We characterized the performance of several HECC systems based on Intel's Xeon Harpertown, Nehalem, and Westmere processors. We have also investigated several performance-related issues such as contention for shared resources, Hyper-Threading, and hybrid programming for multi-core systems.

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Visualizations from a large-scale simulation of the Earth's magnetosphere enabled by the APP group's 3DH code optimization efforts. *Homa Karimabadi, University of California, San Diego/SciberQuest*